

ANALYSIS OF THE EFFECT OF ADDITION OF EVocreTE ON THE CHARACTERISTICS OF PEAT SOIL

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Abstract: Peat soils are soils with low load-bearing, high compressibility and very saturated in water, which requires stabilization before their use as a foundation layer. This study examines the effect of the addition of Evocrete additives and an Evocrete-lime combination on improving the physical and mechanical properties of fibrous peat soils. Analyses include water content, density, organic matter content, ash content, fiber content, pH, as well as mechanical tests such as compaction test, simple compressive strength test (UCS), and UU triaxial test. Different proportions of Evocrete were used, from 5% to 25%, as well as a combination of 25% Evocrete and lime, at percentages ranging from 5% to 25%. The results showed that the addition of Evocrete increased dry density, shear strength, and compressive strength. The combination of Evocrete and lime allowed for a more significant increase, particularly for an Evocrete content of 25% and a lime content of 15% to 20%. In conclusion, Evocrete effectively improves the mechanical properties of peat soils and optimal performance is achieved through the Evocrete-lime combination.

Keywords: Peat soil, stabilization, UU Triaxial test, Unconfined Compressive Strength (UCS) test, Evocrete, Lime.

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1. INTRODUCTION

Peat soils are widespread in Indonesia and are a challenge for civil engineering due to their extreme softness, high water content, and high compressibility. Peat is rich in organic and fibrous matter, and has extreme porosity, making it unsuitable for direct use as a base layer for pavements. Stabilization methods are necessary to increase its bearing capacity and reduce deformation in the long term. Previous studies have shown that chemical stabilization with lime, cement, fly ash, or other materials can improve peat strength. However, the use of alternative materials such as Evocrete, a natural mineral based on calcium chloride dihydrate, remains limited. Evocrete accelerates hydration and increases the crystallization of soil microstructures, which can increase shear strength and peat density.

The sample variations of previous research (Tampubolon, 2020), at 10% of Evocrete. This research extends the concentration range of Evocrete to 25% and combines it with lime to achieve the

optimal formulation. The aims of the research to analyze the effectiveness of Evocrete and Evocrete-Lime to improve the physical and mechanical characteristics of peat soils, as well as to determine the optimal percentage of mixing for foundation stabilization in the construction sector. Infrastructure development in Indonesia, particularly roads, often faces challenges posed by peat soils. These soils have unfavourable properties, such as very highwater content, low bearing capacity and extreme compressibility, making them unsuitable for the construction of foundations without specific treatment. Stabilizing soils is an essential solution to improve their mechanical properties.

The objectives of this research are to analyze the effect of stabilizing peat soils with mixtures of Evocrete and mixtures of Evocrete and lime on simple compressive strength (SCR) and triaxial strength and determine the optimal percentage of Evocrete and lime mixtures to achieve the best stabilization results. A peat soil is a soil with a very high organic matter and water content, a high void index and the presence of fibres. Technically, it is



characterized by high compressibility, low primary compressibility, creep compressibility (compressibility at constant effective pressure) and low bearing capacity.

According to ASTM D-4427 (1992), there are three types of peat soils: (1) The fibrous soil, which is not very decomposed (raw peat), still contains many fibres (> 67%); (2) The heme soil, partially decomposed (moderately mature peat), represents a transition between the fibrous soil and the supraic soil. It still contains fiber (33% to 67%), and (3) The supraic soil, the most decomposed (mature peat), has a low fibre content (< 33%). Soil stabilization. The stabilization of soils aims to increase their load-bearing. If the existing soil is very loose and easily compressible, or if it has an unsuitable consistency rating, excessive permeability, or other undesirable properties that make it unsuitable for a

construction project, then it is necessary to stabilize it (Bowles, 1991).

2. METODOLOGY

Peat soil samples were collected from Cinta Jaya village, Pedamaran district, Ogan Komering Ilir regency, South Sumatra. The location of this research is shown in Figure 2. Laboratory analyses were carried out to determine the physical and mechanical properties of the soil before and after stabilization. These analyses included Physical properties and Mechanical properties. Physical properties include: Moisture content (ASTM D 2974-14); Density (ASTM D 854-14); Fiber Content (ASTM D 1997-13); and Ash Content (ASTM D 2974-14). Mechanical properties: include: Compaction (ASTM D 698-12); Unconfined compressive strength (UCS, SNI 1744-2012); Triaxial test (ASTM D-2850-95).



Figure 2: Research Location

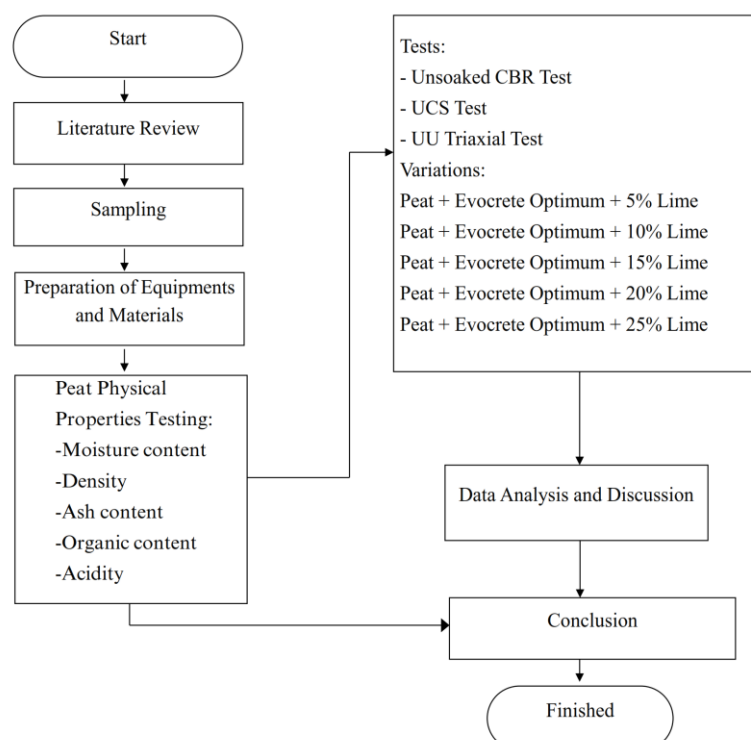


Figure 1: Research Methodology

The materials used in this study were peat samples. The stabilizers used were lime (CaCO_3) and EvoCrete, a natural product based on minerals that is environmentally friendly (Figure 2). The peat used was dried and sieved until it passed through a No. 4 sieve. Soil samples were collected at a depth of approximately 100 cm below the surface.

1. EvoCrete is an advanced blend modifier based on natural minerals that enhances and accelerates the chemical stabilization process. Its effectiveness comes from its content of calcium chloride dihydrate, which is rich in alkali and alkaline earth metals. Its main mechanism of action is divided into two: accelerated hydration and improved crystallization. This product is manufactured by Shamrock Geo Science LTD, Francis Rachel Street.
2. The lime used in this research was DFA 80 mesh dolomitic lime, a mineral lime used for soil stabilization and improvement. Its operation is based on the principle that a finer particle size significantly increases the chemical reactivity of the material. It is calcium magnesium carbonate (CaMgCO_3).

Variations of compaction test specimen mixtures for (a) peat soil, (b) Peat + Evocrete (5%, 10%, 15%, 20%, 25%) as many as five samples, and (c) Peat + Evocrete (% max) + lime (5%, 10%, 15%, 20%, 25%) as many as 5 samples each. In this mixed variant, tightening was performed for 4 days during the fabrication of the free compressive strength (UCS) test and Triaxial UU.



Figure 2: Lime and EvoCrete,

3. RESULTS AND DISCUSSION

The peat soil used in this test was obtained from Cinta Jaya Village, Pedamaran District, Ogan Komering Ilir Regency, South Sumatra Province. The test of physical and mechanical properties

included water content, specific gravity, fiber content, organic matter, ash content, and acidity (pH), Compaction, Unconfined compressive strength, and Triaxial test. The test was conducted in the soil mechanics laboratory of the Civil Engineering Department, Faculty of Engineering, Universitas Sriwijaya. Summary test results of peat soil are explained in Table 1.

Table 1 : Summary Test Results of Peat Soil

No.	Parameter		
Physical properties			
1	Water Content	360,03	%
2	Organic Content	67,51	%
3	Fiber Content	24,59	%
4	Acidity (pH)	3.4	-
5	Specific gravity (GS)	15.39	-
6	Density	1,31	gr/cm ³
Mechanical properties (optimal condition)			
7	Optimum Water Content (OMC)	40.76	%
8	Maximum Dry Weight (MDD)	0,91	gr/cm ³
9	Shear strength (t)	0,15	kg/cm ²
10	Kohesi (c) (UU Triaxial)	0,13	kg/cm ²
11	Internal Friction Angle (ϕ)	1,45	°

In general, this material has soil characteristics with physical properties dominated by a very high moisture content (360.034%) and a high organic content (67.51%), as well as a very low acidity (pH) (3,4). This indicates that the sample is a very moist, organic-rich, and highly acidic material. In terms of mechanical properties, the optimum moisture content (OMC) value is 40.76% with a maximum dry weight (MDA) of 0.915 gr/cm³. Nevertheless, the material has a very low unconfined free compressive strength (S_u) of 0.1498 kg/cm², as well as a cohesion value of (c) of 0.117 kg/cm² and Internal Friction Angle (ϕ) of 1.449, which overall implies that the material has a very low bearing capacity and stability, probably due to its excessive water and organic matter content. Overall, the results of a series of mechanical tests including the optimal moisture content, the triaxial UU test and the unconfined compressive strength (UCS) test can be summarized as follows:

3.1. Optimum Water Content Testing with Evocrete

The results of the optimal peat moisture content + evocrete can be found in the Table 1. From the data in the table, it can be concluded that as the percentage of Evocrete increases, the optimal moisture content tends to decrease. The Optimum Water Content has decreased (from 38.70% to 30.62%). The maximum dry density has been steadily increasing.

Table 2: Test Results for Optimum Water Content and Maximum Dry Density of Peat + Evocrete

No	Sample	Code	Optimum Water Content (%)	Maximum dry density (gr/cm ³)
1	G + E 5 %	E5	38.70	0.982
2	G + E 10 %	E10	36.40	1.048
3	G + E 15 %	E15	34.01	1.081
4	G + E 20 %	E20	32.65	1.115
5	G + E 25 %	E25	30.62	1.145

3.2. Optimal moisture test with Evocrete + Lime

According to the results of the tests of the optimal moisture content of peat + avocado + lime, it can be seen in the Table 3. The combination of Evocrete and Lime gives more optimal results than a single Evocrete. The maximum value of is recorded at a mixture of E 25% + K 5% with the value. This value is higher than the maximum MDA on a single Evocrete mixture. This upgrade confirms the synergistic effect between Evocrete and Lime.

Table 3: Optimal moisture content and maximum dry density test results: peat + Evocrete + lime

No	Sample	Code	Optimum Water Content (%)	Maximum dry density (gr/cm ³)
1	E 25 % + k 5 %	EK5	24,01	1,225
2	E 25 % + k 10 %	EK10	24,50	1,195
3	E 25 % + k 15 %	EK15	27,65	1,205
4	E 25 % + k 20 %	EK20	29,00	1,190
5	E 25 % + k 25 %	Euro 25	30,25	1,215

3.3. Triaxial UU Peat Test + Evocrete

The following are the test results of the Triaxial UU Peat + Evocrete which can be seen in Table 4. The cohesion value (c) tends to increase with increasing Evocrete percentage, reaching 25% Evocrete. This increase confirms the formation of cementitious bonds due to Evocrete which increases the adhesion and shear resistance between soil particles. Meanwhile, the Internal Friction Angle (ϕ) value shows fluctuations, indicating that Evocrete is more dominant in improving Cohesion than shear interlocation.

Table 4: Results of the peat Triaxial UU test + Evocrete:

No	Sample	Code	Internal Friction Angle (ϕ) (°)	Cohesion (c) (kg/cm ²)	Shear Strength (kg/cm ²)
1	G + E 0 %	E0	1,449	0,117	0,119
2	G + E 5 %	E5	15,01	0,193	0,219
3	G + E 10 %	E10	13,36	0,207	0,232
4	G + E 15 %	E15	14,73	0,218	0,246
5	G + E 20 %	E20	20,24	0,285	0,326
6	G + E 25 %	E25	9,84	0,315	0,335

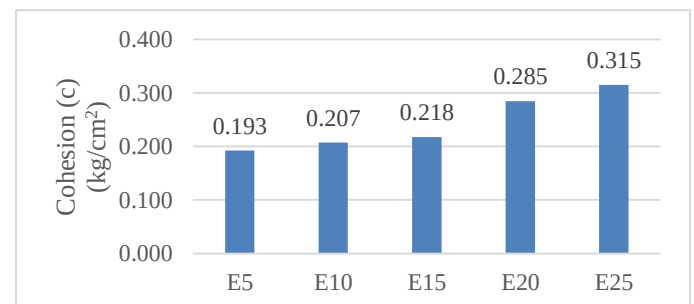


Figure 3 : Triaxial UU Test graph for peat + Evocrete

3.4. Triaxial UU Test of Peat Soil + Evocrete + Lime

The addition of 25% Lime to Evocrete resulted in a very significant increase in Cohesion (c), reaching a maximum value at 25% E + 25% K. This value is the highest of all tests, indicating that Lime effectively increases the cementation reaction, resulting in a soil matrix that is much stronger and more resistant to shear failure. This increase in Cohesion is crucial in improving the short-term stability of peat soil.

Table 5: Results of Triaxial UU Test of Peat Soil + Evocrete + Lime

No	Sample	Code	Internal Friction Angle (ϕ) (°)	Cohesion (c) (kg/cm ²)	Shear Strength (kg/cm ²)
1	E 25 % + k 5 %	EK5	10,47	0,304	0,327
2	E 25 % + k 10 %	EK10	20,90	0,319	0,364
3	E 25 % + k 15 %	EK15	11,35	0,321	0,345
4	E 25 % + k 20 %	EK20	13,15	0,350	0,378
5	E 25 % + k 25 %	EK25	11,54	0,488	0,513

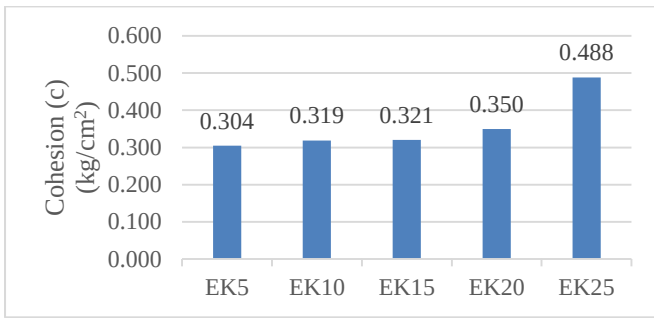


Figure 4 : Triaxial Test Graph for Peat + Evocrete + Lime

3.5. Unconfined Compressive Strength (UCS) Test Results Peat + Evocrete

Unconfined compression strength testing is conducted to evaluate the ability of a soil sample to withstand compressive loads without any confining pressure. The results of the unconfined compression strength test can be seen in Table 6. Test results show that as the Evocrete percentage increases, reaching 25% Evocrete, this increase is accompanied by increases in density and cohesion, indicating that Evocrete successfully increases the stiffness and compressive strength of peat soil.

Table 6: Results of the Unconfined Compressive Strength (UCS) Test Peat + Evocrete:

No	Sample	Code	Unconfined Compressive strength (qu) (kg/cm ²)	Axial strain (%)
1	G + E 0 %	E0	0,1498	3,563
2	G + E 5 %	E5	0,1714	4,847
3	G + E 10 %	E10	0,2005	6,012
4	G + E 15 %	E15	0,2011	5,891
5	G + E 20 %	E20	0,2259	7,239
6	G + E 25 %	E25	0,2839	9,620

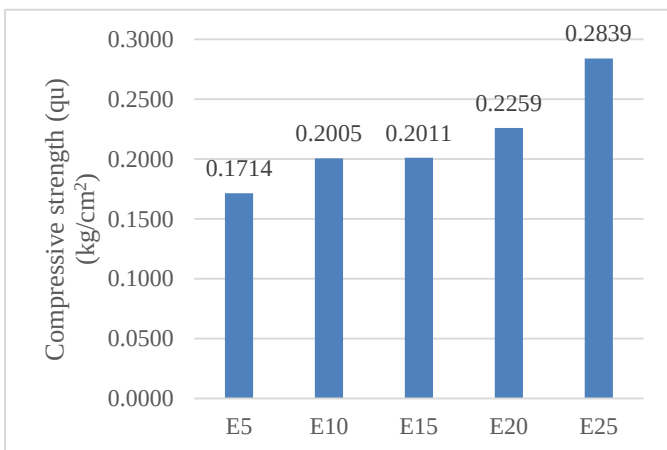


Figure 5: Graph of The Compressive Strength Test For Peat + Evocrete.

3.6. Unconfined Compressive Strength (UCS) Test Results Peat + Evocrete + Lime

Unconfined compression strength testing is conducted to evaluate the ability of a soil sample to withstand compressive loads without any confining pressure. The results of the unconfined compression strength test can be seen in Table 7. The addition of lime resulted in optimal improvement, reaching the highest value at E 25% + K 25%. This increase in compressive strength was almost double that of Evocrete 25% alone, proving that the synergy of the two stabilizers is very effective in creating a strong cementitious bond, resulting in a material that is more resistant to vertical compressive loads.

Table 7 : Unconfined Compressive Strength (UCS) Test Results Peat + Evocrete + Lime:

Not	Example Name	Sample Code	Unconfined Compressive strength (qu) (kg/cm ²)	Axial strain (%)
1	E 25 % + k 5 %	EK5	0,2933	11,213
2	E 25 % + k 10 %	EK10	0,3063	10,667
3	E 25 % + k 15 %	EK15	0,3572	11,853
4	E 25 % + k 20 %	EK20	0,3790	12,842
5	E 25 % + k 25 %	EK25	0,4883	12,667

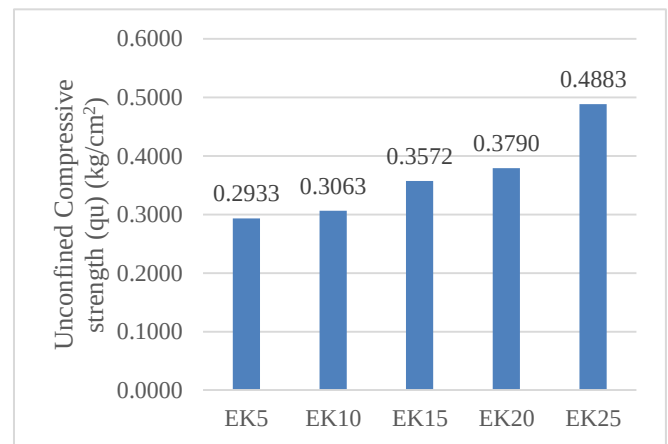


Figure 6 : Graph of The Unconfined Compressive Strength Test For Peat + Evocrete + Lime

4. CONSLUSION

Based on the results of the tests of the physical and mechanical properties of fibrous peat soils stabilized with a single Evocrete and a combination of Evocrete and Lime, the conclusions drawn according to the formulation of this research problem are as follows:

Effect of single-evocrete stabilization and evocrete-lime combination on peat soil characteristics. Stabilizing peat soils using a single Evocrete or in combination with lime significantly improved the mechanical parameters of the soil. Evocrete alone is the most effective at 25%, resulting in a maximum value of unconfined compressive strength (UCS). The combination of Evocrete and Lime offers the most radical improvement, especially in the cohesion value (c), which is the main factor in the increase in shear strength by cementing reactions, showing a very significant improvement in the load-bearing capacity of the soil, which gives it the potential to be a better subsoil. The value of the deep slip angle (ϕ) indicates a more varied trend but tends to increase.

The Most Optimal Percentage of Avocado and Lime Blend, The optimal percentage of Evocrete and lime mixtures for the stabilization of fibrous peat soils is based on the best achievement of the highest values on the main mechanical parameters (UCS, Cohesion and ϕ), i.e. in the mixture E25% + K 25%, it gives the highest values of UCS and cohesion among all the mixed variations tested. These results show that the addition of lime as a new activator to evocrete, at a percentage of 25%, maximizes the cementation reaction, thus providing the highest stability and mechanical strength for fibrous peat soils

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